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# *Gaian Views*

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> Above the smoke and stir of this dim spot
> Which men call Earth.
> —John Milton (1608–1674)

THE GAIAN VIEW—or rather Gaian views, since they have begun to be analyzed and there are many of them[1]—range from the logical extreme of a reproducing Earth[2] to the more modest and scientific formulations of Margulis[3] and Lovelock.[4] We have no wish to homogenize religious and scientific views of what *Gaia* might mean. Nevertheless, it has become clear that no simple scientific or even well-intended metascientific statement (of Gaia's status as a paradigm shift or rupture in the thought-collective)[5] will encompass Gaia in its richness or define it in its fullness.

In its current application the term *Gaia* was coined by William Golding, the author of *Lord of the Flies* and a country neighbor of atmospheric chemist James Lovelock, inventor of the device that detects chlorofluorocarbons in the air. Lovelock had been working on a new concept which he referred to as "life as seen through the atmosphere," or "a cybernetic planetary system with homeostatic tendencies."[6] Lovelock ran into Golding one day in a shop in Bowerchalke, Wiltshire, the small village in southern England where they both lived. Frustrated by his attempts to express his new theory, Lovelock asked Golding if he could please give him a "good four-letter word" referring to Earth in order to focus the attention of scientific colleagues. Golding responded with "Gaia," from the Greek goddess of the Earth, mother of the Titans.[7] In Greek mythology Gaia personifies Earth. The alternative spelling of Gaia, *Gaea*,[8] is already rooted in "scientific" English words such as geometry, geology, and geography.

In the early sixties Lovelock took on an assignment that wrestled with the problem of how to tell—in a more subtle way than seeing if an alien giraffe, or whatever, walks in front of the camera—if a planet is covered with life. Lovelock realized that simply looking for forms of life was not the best way to go about detecting its presence. Rather, he thought, the best way to detect life was by chemically looking for its waste, especially chem-

ically reactive gases that ought not coexist. Any organism alive is always producing gas, and the atmosphere is a reservoir of the gases of a planetary covering of organisms. Lovelock became convinced that atmospheric measurements alone could determine whether or not life were on the surface of a given planet.[9]

The Gaia Hypothesis can be understood by looking at a chart of planetary atmospheres. The planet Earth, between Venus and Mars, is the third planet from the sun. Venus is a very hot planet and its clouds are full of sulfuric acid droplets. Mars has a much thinner atmosphere than Venus or Earth and is very cold. Its dry surface is covered with volcanic rubble, craters, and other evidence of meteoritic impacts. Despite these dramatic differences, the atmospheres of Mars and Venus are both more than 90 percent carbon dioxide, and are virtually identical. In contrast, the Earth is anomalous; it has far too much oxygen and far too little carbon dioxide. Not only is the Earth very different but the differences are shocking. While the Earth's atmosphere is full of highly reactive gases, it lacks carbon dioxide, and there is no good astronomical, physical, or chemical explanation for this anomaly. Lovelock held that the anomalous mixture of gases in the Earth's atmosphere, the lack of carbon dioxide and the presence of oxygen, was biological: The atmosphere was produced and maintained by life.

But the carbon dioxide has not left the Earth; rather, it has been transferred. For example, it can be found wrapped up in communities of petrified bacteria—reef-like limestones that were first produced in the ocean. These vaguely monstrous rocks grow. Called *stromatolites,* they are composed of calcium carbonate, the carbonate portion coming from the carbon dioxide of the air. Year after year, photosynthetic bacteria take carbon dioxide from the air and alter it into limestone rock. Simultaneously, the bacteria that remove this carbon dioxide also produce oxygen, the gas so vital to surface life on Earth. It is estimated that when bacteria first appeared on Earth, the concentration of oxygen was less than one part per billion; now, the atmosphere is 20 percent oxygen. When it was first produced, oxygen was a dangerous toxin, without doubt a pollutant, but now this gas is the primary fuel for respiring bacteria and the cells in the muscle tissue of animals.

Although oxygen is a reactive gas, poisonous to all organisms at concentrations higher than those to which they are adapted, oxygen is wholly of biological origin. It is the natural tendency of all living organisms to try to convert material into their cells, to grow and continue growing, and to ravage their environs in so doing. The pollution first from methane and then from oxygen released by bacteria gave rise to a flurry of other interacting gases, all of which were inhaled, reprocessed, and then exhaled by one or another of a diversity of incessantly moving and mutating beings.

All of the living organisms on the face of the Earth are connected in the sense that one kind removes the waste of another, that organisms breathe each other's wastes. Organisms are not so much individuals as parts of systemic life at various levels of integration. Diversity is an absolute requirement for moving materials across the Earth's surface. No one kind of organism can by itself simply grow to the ends of the Earth because it would drown in its own waste. Waste removers and food producers rather work in unison, and the only true individual in the sense of independence is Gaia, the global nexus of life itself—and yes, even Gaia depends on the sun.[10]

People evolved within the variegated Gaian system some three million years ago. Modern groups of people appeared maybe thirty or forty thousand years ago. And whereas marine and other animals are just 700 million years old, life as a phenomenon on the surface of the planet is four billion years old. Humans are thus very recent. All of our preoccupations are very recent; we have an extraordinarily short-sighted mammalocentric view. Part of the challenge of the Gaia idea is for people to see themselves as one very small and very recent part of a much larger and older system.

Gaia is the child of a fertile union between Lovelock's mind and NASA's search for life on Mars. Tagged "a way of knowing,"[11] Gaia may not be simply one world view among others. It is better described as an interdisciplinary scientific approach combining astronomy, biology, biochemistry, remote-sensing technology, thermodynamics,[12] and atmospheric chemistry. Moreover, Gaia has blasted off from its scientific base and entered the wishful stratosphere that is "New Age" discourse. Even a cursory sociological study would reveal that Gaia has been attacked not only for being unscientific[13] and "untestable,"[14] but as antihuman polemics, "green" politics, industrial apologetics, and even as a non-Christian ecological "satanism".[15] Such a diversity of enemies indicates that Gaia as an idea has grown beyond the sheltered realm of institutional academia.

But Gaia is no more exhausted by the negative approaches of its critics in analytical philosophy than it is by the maudlin adulation of its ecomanic adherents. Outside science, Gaia has become the darling of the "green" or ecology movement. Gaia is to the intellect what the satellite view of the "whole Earth" is to the eye. Essayist-physician Lewis Thomas identified satellite photographs of Earth with the Gaian view by claiming that the Earth, from space, actually looks alive. Contrasting with the dead-as-old-bone moon, the Earth is the only "exuberant thing in this part of the cosmos," says Thomas, with the "organized, self-contained look of a live creature, full of information, marvelously skilled in handling the sun."[16] Gaia, the meditation upon the Earth as a living being, can be seen to be part of a philosophical monism and ancient animism that regards the cosmos as living. As such it reawakens premodern but not entirely prescientific

sentiments. Such a meditation may be consonant with non-Copenhagen interpretations of quantum mechanical equations and data that suggest that the smallest parts of matter are already always wavelike, in nonlocal or transdimensional correspondence, unpredictable, integrally related to the experimenter and experimental apparatus, and perhaps even "conscious." The depth and breadth of Gaia theory offers an excellent opportunity for historians and philosophers of science to chronicle a scientific revolution in the making. It is a striking reminder that science, in the initial spasms of its birth, cannot always be rigorously distinguished from prescientific, magical, or pseudoscientific systems of thought. Science, according to standard ethnographic and anthropological thought, evolutionarily grows out of religion just as religion grows out of magic (and as the infant grows out of his imaginary world into a greater dependence on rationality). The great 19th-century critic of Darwin, Samuel Butler, warned that the scientist is an augur, a medicine man, the priest in his most modern guise and, while useful, requires us to watch over him very closely. From a Butlerian perspective, science may be a sort of religion that will not permit itself to be recognized as such: a system of beliefs still being actively reworked, not yet settled into the ground of primordial assumptions, not yet learned so perfectly and repeated so often that it has been forgotten or entered into the realm of cultural unconsciousness.

### *The Metascientific*

> What is the Earth but a lump of clay surrounded by water?
>
> —Bhartrihari: *The Vairagua Sataka*, c. 625

The metascientific topos that engulfs Gaian science is at once mythological and ecological. The need for a Gaian science is attributable to the exponential growth of human beings in the biosphere. Several billion trading, settling, warring, urbanizing, reproducing, largely technological human beings inhabit the surface of planet Earth. From an evolutionary epistomological viewpoint, it appears that we must, to survive in present numbers, adopt some version of the Gaia hypothesis: Only science has the international status necessary to induce human behavioral changes on a global scale.

Gaia science, geophysiology, operates out of the metaphor that the planet is not just a home (Greek *oikos*, the etymological root of ecology) but a body. A body differs from an inert place in that it is sentient, physiological, and reactive: Indeed, whereas the difference between referring to Earth as a "living planet"[17] and a planet that is "alive"[18] may seem minor, de-

bating it has proved contentious, distressing biologists, geologists, meteorologists, and others.

Admission of a live Earth leads toward the scientifically forbidden territory of animism—a stratum of personification, anthropomorphism, and narcissistic magical beliefs that have, according to positivistic ideology, long been overcome by the progress of "objective" science. Some scientific reservations concerning Gaia are neatly bypassed by avoiding all partisanship with teleology; attributions of purposeful behavior are omitted simply by referring to Gaian functions in the technical language of cybernetics, biogeochemistry, or physiology. Nonetheless, the Gaian concept of a live Earth leads, if not always to a recrudescence of totem worship and animism, at least to a redefinition of life. But since life has never been satisfactorily defined in the first place, although Schroedinger's remarks about its being away from thermodynamic equilibrium were crucial to Lovelock's original formulations of Gaia, the apparent need to redefine life in the context of Gaia theory only makes that original definition all the more problematic.

Metascientifically, Gaia has narrowed the space, or expanded the continuum between life and nonlife, the organic and the inorganic, the animate and the inanimate. In Gaia theory, for example, the atmosphere becomes part of the biosphere, a sort of global circulatory system; the bacteria-laden limestones and microbe-rich topsoils are no longer inert substrata but rather living tissues at the planetary surface. In the most speculative extensions of the Gaia hypothesis, the living biosphere provisionally encompasses not only the atmosphere and its clouds, but plate tectonics, the regulation of ocean salinity, and mammal-like planetary thermostasis. These regulatory properties have persisted over a period of some three billion years. This new-found attention to our surroundings as a body implies a transvaluation of values from the ecological to the physiological, giving our technical civilization a chance to recognize, alter, and even guide humanity's role within the environment.

The "textbook" view of life is that it comprises millions of independent beings that inhabit inanimate surroundings. Such a traditional view of the biosphere was espoused even by forward-thinking individuals such as Buckminster Fuller. His metaphor of "Spaceship Earth" has technocratic and mechanistic ramifications. It perpetuates the conceit of human control and mastery of an essentially inanimate environment.

In Gaia theory, by contrast, the air and ground are not independent inorganic chemicals; rather, the sediments and atmosphere have been worked into an entire living system. From the Gaian perspective, human air pollution on a global scale perturbs not just the atmosphere but affects all the biota.

In this interconnected and interpenetrating view, we find the basis for a human action that recognizes rather than ignores our geophysiological involvement within a growing, changing global body.

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*Notes*

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